Assessment on a blended teaching model for surgical laboratory course among international medical students in response to the COVID-19 pandemic: a case study in a Chinese university

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Abstract

Background

With the ongoing crisis of the COVID-19 pandemic in China and the increasing online teaching platforms, the blended teaching model for international medical students is necessary. Our study aims at assessing the effectiveness of the combination of online and classroom teaching in surgical laboratory course among international medical students in a Chinese university.

Methods

This was a cross-sectional study conducted in a Chinese university. All international medical students enrolled in 2016–2019 were included in our study and were all third year undergraduate students majoring in Clinical Medicine for a 5-year program. At the final stage of the surgical laboratory course learning, the scores of OSCE (Objective Structured Clinical Examination) and the performance of usual learning and the skills practice from 2019 to 2022 were used as measures to assess the effectiveness. STATA 14 software was applied to conduct the relevant descriptive and statistical analysis. The statistical significance was set at \( P < 0.05 \).

Results

A total of 29 international medical students from 14 developing countries were included in our study. The mean age of them was 25.5 ± 2.2 years. The mean scores of OSCE was 76.55 ± 21.91, and it was 76.80 ± 22.05 for the usual learning and skill practice among all the international medical students. The mean scores of OSCE was 75.69 ± 21.40 for the international medical students in the blended teaching model, close to that (77.47 ± 23.21) in the traditional teaching model. Besides, the mean scores of usual learning and skill practice for the international medical students in the blended teaching model was 74.40 ± 20.92, lower than that (77.43 ± 23.18) in the traditional teaching model (\( P > 0.05 \)).

Conclusions

Our study as a preliminary study confirmed that a blended teaching model was effective like the traditional teaching model, which can reduce the disruption for the international medical students’ study during the COVID-19 pandemic. Online interactions between international medical students and instructors positively contribute to global health education. Better coordination of online and face-to-face blended teaching models is an important direction for global medical education.

Background
The COVID-19 pandemic has been still ongoing in China. Currently, China has remained a ‘dynamic zero-COVID-19’ policy in order to control the COVID-19 as far as possible at the minimum cost (1). The COVID-19 has resulted in huge changes in people's daily life, including medical education (2, 3). Medical universities or schools as a high risk to exposure to the COVID-19 need to be shut down when all level of the governments require students and educators to stay at home (4). This has disrupted traditional medical education, which are mostly presented in clinical clerkships and face-to-face teaching activities. Online distance medical study has become part of medical education during the COVID-19 pandemic (4, 5).

China has been the third largest destination country globally to attract international students for higher education (6). Especially, medicine is the most common program chosen by international students in China (7). On one hand, a portion of international students have chosen to go back to their home countries the COVID-19 pandemic. Due to international travel restrictions and cost at quarantine hotels during the COVID-19 pandemic set by Chinese government (8), some international students cannot go back to China for their study. Therefore, online distance medical study is a must for them to keep on studying. One the other hand, those international students who can still stay in China are able to attend the lectures and participate in clinical clerkships in person. Hence, a blended teaching model has become common for global medical education (9).

A blended teaching model is a teaching activity which combines online self-learning/teaching and classroom teaching (10, 11). Current studies have confirmed that a blended teaching model is applied to medical education. For example, Wu et al. has developed a clinical teaching blended learning (CTBL) program with the aid of web-based clinical pedagogy (WCP) and case-based learning for nurse preceptors (12). Coyle et al. conducted a narrative review to describe the application of blended learning to a sexual health education program (13). Both of them have provided evidence that a blended teaching model is effective and feasible.

Surgical laboratory course is one of the basic surgical courses for medical students to get knowledge and practice. With the ongoing crisis of the COVID-19 pandemic in China and the increasing online teaching platforms, the blended teaching model for international medical students is necessary. The blended teaching model used in teaching surgical laboratory course for international medical students is innovative. It is necessary to assess the effectiveness of the blended teaching model. Therefore, our study aims at assessing the effectiveness of the combination of online teaching and classroom teaching in surgical laboratory course among international medical students in a Chinese university.

**Methods**

**Setting**

This cross-sectional study was conducted in Wuhan University (WHU), which is a comprehensive and key national university directly under the administration of the Ministry of Education in China. It is also one of
the “211 Project” and “985 Project” universities in China. School of Medicine is one of the schools in WHU and Zhongnan Hospital of Wuhan University is one of three affiliated hospitals where medical students can participate in clinical clerkships. Currently, a total of 1623 international students are studying in WHU.

**Study participants**

All international medical students who were enrolled in 2016–2019 were included in our study. These international students were all 2-year undergraduate students majoring in Clinical Medicine for 5 years (2016 class, 2017 class, 2018 class, and 2019 class). Informed consent was obtained from the international students and the results would be published without any potential possibility to share any information about personal data.

The blended teaching model for *surgical laboratory course*

Traditional teaching model (face-to-face teaching): International medical students were required to independently complete the assigned reading material, including theoretical knowledge, operational overview, and step-by-step instructions for surgical laboratory course prior to classroom teaching. In the first 20–30 minutes of the class, the instructor summarised the main points of the skills and the application of laboratory equipment and precautions. Then, the students practiced their medical simulation skills after class.

Online teaching model: With the full support from online platforms of WHU Luojia, our team has established a Massive Open Online Course (MOOC) for the international medical students. This can provide micro videos, extra reading material relevant to surgical laboratory course, and online assignments and assessments. Besides, we also provided the international medical students with online relevant information about the surgical laboratory course to help them get the most of knowledge.

Therefore, those international students enrolled in 2016 and 2017 only attend the traditional teaching model, while those enrolled in 2018 and 2019 attended both the traditional teaching model and online teaching model. Please see Fig. 1.

**Assessment measures on the blended teaching model for surgical laboratory course**

All the international medical students were required to attend the lectures according to undergraduate medical course guidelines set by WHU. The course contents, reading materials, and assessment methods have been keeping the same. At the final stage of the surgical laboratory course learning, the international medical students needed to take part in the Objective Structured Clinical Examination (OSCE). The scores of OSCE accounted for 60% of the final results, while the scores of the performance of usual learning like attendance and the skills practice accounted for 40% of the final results. Therefore, the scores of OSCE and the performance of usual learning and the skills practice from 2019 to 2022 were used as measures to assess the effectiveness of the blended teaching model.
Data analysis

The data were all entered in Excel file by two independent researchers in order to make sure of the data quality. Numerous data were presented in mean and standard deviation (SD) and independent $t$ test was used to conclude the causal effects. Categorical data were presented in percentages and sums, and Chi-square test was used to conclude the causal effects. STATA 14 software was applied to conduct the relevant statistical analysis. The statistical significance was set at $P<0.05$.

Results

Characteristics of the included international medical students

As shown in Table 1, a total of 29 international medical students from 14 developing countries were included in our study. The mean age of all the international medical students was 25.5 ± 2.2 years. The mean age of the international medical students participating in the traditional teaching model was 26.6 ± 2.1 years, which was higher than that of those international medical students participating in the blended teaching model (24.4 ± 1.7 years). Moreover, more male international medical students were in the blended teaching model, while more female international medical students were in the traditional teaching model.
Table 1
Characteristics of the included international medical students

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Blended teaching model</th>
<th>Traditional teaching model</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (mean ± SD)</td>
<td>24.4 ± 1.7</td>
<td>26.6 ± 2.1</td>
<td>25.5 ± 2.2</td>
</tr>
<tr>
<td>Gender (N)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>11</td>
<td>5</td>
<td>16</td>
</tr>
<tr>
<td>Female</td>
<td>4</td>
<td>9</td>
<td>13</td>
</tr>
<tr>
<td>Origin of country (N)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
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<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Chad</td>
<td>5</td>
<td>1</td>
<td>6</td>
</tr>
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<td>1</td>
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<td>Morocco</td>
<td>-</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
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<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Indonesia</td>
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<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Somalia</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
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<td>-</td>
<td>1</td>
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<td>Kazakhstan</td>
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<td>-</td>
<td>1</td>
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<td>-</td>
<td>1</td>
</tr>
<tr>
<td>Yemen</td>
<td>1</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>Cambodia</td>
<td>1</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>Total (N)</td>
<td>15</td>
<td>14</td>
<td>29</td>
</tr>
</tbody>
</table>

Differences on scores of OSCE and the performance of usual learning and skills practice between the blended teaching model and the traditional teaching model

Table 2 presents that the mean scores of OSCE was 76.55 ± 21.91, while it was 76.80 ± 22.05 for the usual learning and skill practice among all the international medical students. The mean scores of OSCE was 75.69 ± 21.40 for the international medical students in the blended teaching model, which was close to that (77.47 ± 23.21) for the international medical students in the traditional teaching model. The difference is not statistically significant (P= 0.831). Besides, the mean scores of usual learning and skill practice for the international medical students in the blended teaching model was 74.40 ± 20.92, which
was lower than that (77.43 ± 23.18) for the international medical students in the traditional teaching model. The difference is not statistically significant ($P = 0.714$).

<table>
<thead>
<tr>
<th>Scores (mean ± SD)</th>
<th>Total</th>
<th>Blended teaching model</th>
<th>Traditional teaching model</th>
<th>t test</th>
<th>$P$ value</th>
</tr>
</thead>
<tbody>
<tr>
<td>OSCE</td>
<td>76.55 ± 21.91</td>
<td>75.69 ± 21.40</td>
<td>77.47 ± 23.21</td>
<td>0.215</td>
<td>0.831</td>
</tr>
<tr>
<td>Usual learning and skills practice</td>
<td>76.80 ± 22.05</td>
<td>74.40 ± 20.92</td>
<td>77.43 ± 23.18</td>
<td>0.370</td>
<td>0.714</td>
</tr>
</tbody>
</table>

**Discussion**

Our study used the surgical laboratory course as an example to show the effectiveness of the blended teaching model. According to our findings, the blended teaching model could achieve the goal of the traditional one by comparing the scores. International medical students could study normally before the COVID-19 pandemic. A study conducted by Agustina provided evidence that blended learning models could improve student learning outcomes among nursing students (14). This also means that a blended teaching model could satisfy the requirements of international medical students suffering the interruption like the COVID-19 pandemic. Besides, unlike the traditional teaching model in which instructor has the domain role, our online and offline blended teaching successfully set international medical students as priority. International medical students had more discretionary time and were more active and motivated to attend the lectures or participate in the clinical clerkships. This blended teaching model also increased the interaction between instructors and international medical students, which can contribute to global medical education.

Since our international medical students are all from developing countries, this requires that not only medical universities or schools in China need to achieve the capacity to complement the blended teaching, but also developing countries can support those international medical students back to home countries to be involved in the blended teaching. Eight independent factors which may have an impact on the blended teaching during the COVID-19 pandemic are summarized in a study (9). They are e-learning environment, e-learning facilitation, e-learning materials, e-learning technical support, instructor’s personal attention, interaction with instructors, interaction with peer students, and laboratory learning environment. To note, the blended teaching model definitely needs the support of information technology, which might be a challenge in some developing countries (15, 16).

The blended teaching model not only enables global medical education for educators, but also minimises disruptions to students’ daily schedules and keep students’ motivation (17, 18). Our study reveals that a blended teaching model incorporating a formative assessment addresses the barriers which prevent international medical students quarantined at home due to the COVID-19 pandemic from synchronising
their learning progress with on-campus medical students. Online distance learning, discussion and interaction are provided through a MOOC system. International medical students can choose to participate in learning either synchronously or asynchronously and are able to attend the lectures of surgical laboratory course at different locations and times. Therefore, the blended teaching model may become the new normal even for the post-COVID-19 pandemic (11, 19).

Improved blended teaching models are currently mostly applied in platforms of universities or schools by various online platforms (20). Their application to global medical education still needs to be elaborated by cross-regional, multi-centre pedagogical pilot designs and empirical studies. Transition from a traditional face-to-face teaching model into a blended teaching model requires concerted efforts and dedicated technical and pedagogical policy support at all levels. On December 9, 2021, the China Consortium of Universities for Global Health (CCUGH) elected Wuhan University as the fifth presidential institution of the Consortium through an anonymous vote at a web conference. CCUGH aims to establish interdisciplinary collaboration and promote knowledge sharing amongst member universities in China to address global health challenges, including global health education. In the future, CCUGH will focus on promoting the popularisation and standardisation of global health education, which will provide a good platform and policy support for the practice and promotion of the improved blended learning strategy in major medical schools worldwide.

By implementing the blended teaching, international medical students are provided with simultaneous, high-quality access to general surgery theory. The fulfilment of the course may require close contact among international medical students. The blended teaching model is an effective way to meet the challenges in the context of the COVID-19 pandemic. In addition, students participating in face-to-face teaching and online interactive learning showed a high level of autonomy in learning and questioning and were highly satisfied with their learning outcomes, and it was effective to reduce the risk of getting COVID-19 (21).

The COVID-19 pandemic has triggered changes in the teaching and assessment of medical education and it would persist for a long period. Strategic innovations that use information technology in conjunction with existing medical teaching methods can address current medical education issues, especially for international medical students. These innovations for continuous improvement and development provide the basis for blended teaching, online learning and formative assessment in global medical education.

Our study also has some limitations. This is a single centre study and the sample size is not enough because of the limited number of international medical students in this Chinese university. Therefore, the findings cannot be widely applied. A multi-centre study and more data need to be conducted to achieve the robust results in the future. Also, comparative analysis between different countries is necessary to learn different education models.

Conclusions
Our study as a preliminary study confirmed that a blended teaching model was effective like the traditional teaching model, which can reduce the disruption for the international medical students’ study during the COVID-19 pandemic. Online interactions between international medical students and instructors positively contribute to global medical education. Better coordination of online and face-to-face blended teaching models is an important direction for global medical education.

**Abbreviations**

**CCUGH:** China Consortium of Universities for Global Health  
**CTBL:** Clinical teaching blended learning  
**MOOC:** Massive Open Online Course  
**OSCE:** Objective Structured Clinical Examination  
**SD:** standard deviation  
**WCP:** Web-based clinical pedagogy  
**WHU:** Wuhan University

**Declarations**

**Ethics approval and consent to participate**

Our study was approved by ethic committee from Zhongnan Hospital of Wuhan University. Informed consent was obtained from the international students and the results would be published without any potential possibility to share any information about personal data.

**Consent for publication**

Consent for publication was obtained from the international students.

**Availability of data and materials**

Data are available from the authors upon reasonable request.

**Competing interests**

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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It is not applicable.

Author contributions

X.W. designed and conducted the study, gave comments on the manuscript, and was in charge of the whole study. Y.W. analysed the data and drafted the manuscript. Y.L. collected and analysed the data. Z.X. conducted the study and gave comments on the manuscript. X.L. drafted and revised the manuscript, and analysed the data. J.L. designed and conducted the study, and gave comments on the manuscript.

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References


Figures
Figure 1
The blended teaching model for surgical laboratory course for international medical students